NIE 11-57
16 July 1957
033872

~~TOP SECRET~~

No. 305

NATIONAL INTELLIGENCE ESTIMATE

NUMBER 11-57

(Supersedes NIE 11-5-55)

SINO-SOVIET BLOC AIR DEFENSE CAPABILITIES THROUGH MID-1962

Submitted by the

DIRECTOR OF CENTRAL INTELLIGENCE

The following intelligence organizations participated in the preparation of this estimate: The Central Intelligence Agency and the intelligence organizations of the Departments of State, the Army, the Navy, the Air Force, The Joint Staff, and the Atomic Energy Commission.

Concurred in by the

INTELLIGENCE ADVISORY COMMITTEE

on 16 July 1957. Concurring were the Special Assistant, Intelligence, Department of State; the Assistant Chief of Staff, Intelligence, Department of the Army; the Director of Naval Intelligence; the Assistant Chief of Staff, Intelligence, USAF; the Deputy Director for Intelligence, The Joint Staff; and the Atomic Energy Commission Representative to the IAC. The Assistant Director, Federal Bureau of Investigation, abstained, the subject being outside of his jurisdiction.

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SINO-SOVIET BLOC AIR DEFENSE CAPABILITIES THROUGH MID-1962

THE PROBLEM

To estimate the scale and nature of Sino-Soviet Bloc air defenses, and probable trends and capabilities through mid-1962.

FOREWORD

This estimate is made within the framework of our previous judgments that the USSR does not now intend to initiate general war deliberately and is not now preparing for general war as of any particular future date. It is based, moreover, on a judgment that the USSR is reasonably assured that the US and its Allies are not now planning the deliberate initiation of general war. The estimate assumes that these conditions will prevail through mid-1962, and that neither domestic or international political changes nor unexpected technological breakthroughs which would alter the general trends in Bloc and Western military capabilities will occur during the period. It also does not consider any change in military force levels which might result from a disarmament agreement.

The estimate does not concern itself with the detailed strategy and tactics that might be employed by US and Allied forces in attacks against the Bloc, nor does it attempt to evaluate in detail the kill probabilities of Bloc air defense weapons against attacking aircraft or missiles. Likewise, the reduction in Western offensive capabilities which might result from an initial Soviet attack, and the reduction in Soviet defensive capabilities which might result from the initial phase of a general war, are not estimated.

An estimate of Soviet air defense capabilities over the next five years is subject not only to the usual uncertainties inherent in future projections, but to additional uncertainties arising from the probable emergence during this period of significant guided missile capabilities, both offensive and defensive, in Western and Soviet forces. On the basis of presently available evidence, the impact of these developments on Soviet air defense programs during the period cannot be estimated with confidence. Fairly broad margins of error must therefore be presumed to apply to the later years covered by the estimate.

CONCLUSIONS

GENERAL

1. We believe that air defense will continue to be given a high priority in the Sino-Soviet Bloc. Primary emphasis is placed on providing defense in depth for key administrative, industrial, and military centers within the USSR. All Bloc forces with capabilities for air defense are integrated into the over-all system. (*Paras. 16–21, 42, 57–58*)

2. At present, the principal elements of over-all Bloc air defense strength are large numbers of fighter aircraft, early warning and ground controlled intercept radars, and antiaircraft artillery weapons. Bloc fighter strength now totals about 14,000 aircraft, virtually all of which are high-performance jet fighters. Of about 10,000 fighters in Soviet units, approximately 1,300 now have at least limited all-weather capabilities. The USSR has made great strides in radar development, and large numbers of modern radars are now in operation. Bloc AAA weapons are capable of high rates of continuously-pointed fire against high-performance aircraft from low altitudes up to about 35,000 feet. (*Paras. 22, 24–28, 35, 42, 47, 49*)

3. A significant addition to Soviet air defenses has been the introduction of guided missile systems. Surface-to-air guided missile installations are now operational in the Moscow area, and there is some evidence that they are under construction at Leningrad. Air-to-air guided missiles could probably now be employed with certain Soviet fighter types. (*Paras. 29–31, 45, 89, 90*)

4. The areas of high concentration of Bloc air defense weapons and associated equipment include that portion of European USSR from the Kola Peninsula to the Caspian Sea, East Germany, Poland, Czechoslovakia, and the Maritime and Sakhalin areas of the Soviet Far East. High defense concentrations are also at some specific locations outside these areas, such as Tashkent, Novosibirsk, and Khabarovsk. (*Paras. 42–44, 47*)

5. The principal current weaknesses in the air defense system are: its limited all-weather fighter capability; the low traffic-handling capabilities of communications and control components; the probable inadequacy of radar height-finding capabilities at high altitudes and inadequate low altitude radar coverage; deficiencies in fighter armament; and the limited early warning time available in Bloc border areas. (*Paras. 23–25, 30–34, 36, 42, 50, 57–58, 93*)

6. Large passive defense organizations contribute to the Bloc's over-all readiness for air defense. We believe, however, that the general population is inadequately prepared against large-scale nuclear attack. (*Paras. 59–68*)

CURRENT CAPABILITIES

7. The following air defense capabilities apply in general to the Bloc's air defense system:

a. Against penetrations conducted during daylight and in clear weather, at altitudes between about 5,000 and about 35,000 feet, the capabilities of the system are greatest. Above 35,000 feet they

would begin to diminish, and above 45,000 feet would fall off markedly; at altitudes below 5,000 feet, they would also be progressively reduced. (*Paras. 26–27, 29, 32–34*)

b. Against penetrations conducted at night and under poor visibility conditions, the capabilities of the system would be considerably reduced. (*Paras. 22, 24, 42*)

c. Against varied penetration tactics utilizing altitude stacking, diversionary maneuvers, decoys, and electronic countermeasures, the capabilities of the air defense system would be diminished through disruption and saturation. (*Paras. 24, 34, 36–38, 57–58*)

8. The approaches to Moscow are by far the most heavily defended area of the Bloc. Moscow's defenses include nearly 1,300 jet day and all-weather fighters, approximately 700 antiaircraft guns, and some 57 surface-to-air guided missile sites. The Moscow missile system, which could include a limited number of nuclear warheads, can probably direct a very high rate of fire against multiple targets at altitudes up to about 60,000 feet. Moscow's defenses are thus estimated to have a high capability to engage large-scale attack under all-weather conditions, but they probably remain vulnerable to very low altitude attack. (*Paras. 29, 45, 91*)

9. The amount of warning time available has a significant effect on the air defense capabilities of the various areas of the Bloc. Moscow and many other targets in the interior could now be provided with more than one hour's radar early warning of attack by present Western aircraft types. The more limited early warning time available in Bloc border areas would reduce the effectiveness of the defenses of even heavily-defended targets in such areas. (*Para. 93*)

10. The USSR is currently capable of jamming and seriously disrupting Western long-range radio communications. It is also believed to have an appreciable capability for jamming Western navigational and bombing radars. On the other hand, operational Bloc air defense electronic equipment is vulnerable to jamming. (*Para. 40*)

FUTURE TRENDS

11. There will probably be a significant change in the composition of Soviet air defense forces during the next five years, primarily because of the influence of guided missile systems. As suitable surface-to-air missiles and associated equipment become available in quantity, a large portion of the medium and some light antiaircraft artillery guns will probably be phased out of the defenses of static targets in the USSR. At present, we can estimate only that the USSR will probably not increase its present numerical fighter strength, and that a decision will probably be taken to begin cutting back the number of Soviet manned interceptors some time late in the period. The numerical strength of Satellite and Chinese Communist AAA and fighter forces will probably continue to be augmented, largely with older equipment retired from Soviet service. (*Paras. 79–81, 89–90, 92*)

12. Significant developments in Bloc air defenses will probably include: the introduction of fighter aircraft with higher performance and better armament, including air-to-air guided missiles and unguided rockets, some possibly equipped with nuclear warheads; an increase in the proportion of all-weather fighters in

Soviet operational units; the advent of new surface-to-air guided missile systems suitable for defense of static targets, field forces, and naval vessels, and their availability to additional major Soviet cities and industrial areas, as well as military units; extensions of early warning and ground controlled intercept radar ranges, and the availability of sufficient radars to provide nearly complete early warning coverage of the Bloc; increases in the traffic-handling capacities of command and control components. (*Paras. 76–86, 89–92, 95, 97–98, 100*)

13. These developments will considerably increase Bloc capabilities for all-weather defense against Western manned aircraft and cruise-type missiles. Nevertheless, at the end of the period, warning times available to Bloc targets in peripheral areas will probably continue to be deficient for fighter interceptors and marginal for surface-to-air missile defenses against the highest-performance Western aircraft and cruise-type missiles. The Bloc will continue to have difficulty in opposing very low altitude attacks. (*Paras. 72, 85, 93–95*)

14. In the field of electronic countermeasures, the advantage is likely to fluctuate between the offense and the defense. However, we estimate that through the period of this estimate, Bloc air defense electronic systems will still be subject to progressive disruption by properly employed diversionary tactics, decoys, saturation techniques and other countermeasures. (*Paras. 100–101*)

15. We believe the USSR will not be able to place in operation a weapon system capable of successfully intercepting ballistic missiles by mid-1962. (*Para. 88*)

DISCUSSION

GENERAL POLICY

16. The Soviet leaders probably believe that the security of the USSR from air attack rests primarily on their over-all political and military posture. They hope to avoid situations which could lead to a Western attack and they hope that their offensive strength will deter attack should such situations arise. They are also trying to reduce the US threat by political and diplomatic action intended to deny use of the overseas bases which are presently essential to a full-scale US attack on the Bloc. Finally, if the Soviet leaders estimated that war was imminent, they would probably attempt to strike the first blow at Western nuclear capabilities in order to reduce the scale of an initial assault on the USSR. Nevertheless, they almost certainly recognize that these measures may be inadequate in themselves to insure the security of the USSR, and that they must therefore strive to achieve a high level of air defense in case war should occur.

17. Soviet concern with the air defense problem became apparent early in the postwar period, when the Soviet leaders evidently came to appreciate that the primary military threat the USSR faced was from growing Western nuclear striking power. Air defense programs were consequently given a high priority. Evidence of this is found in the rapid development of a jet fighter force, the early establishment of an extensive Bloc early warning screen, the continuing effort to modernize the air defense system and the periodic and extensive air defense exercises. It is also apparent that the Bloc's air defense system has been organized and equipped so as to provide defense in depth for key Soviet administrative, industrial and military centers, with con-

siderably less emphasis placed on the defense of less essential strengths, especially those of the Satellites and Communist China. We believe that Bloc air defense programs will continue to be conducted within this broad policy framework during the period of this estimate.

PRESENT BLOC AIR DEFENSES

OPERATIONAL ORGANIZATION

18. There has been no basic change in the organization of Bloc air defenses since publication of our last air defense estimate, NIE 11–5–55, in July 1955. In the USSR, the Ministry of Defense retains responsibility for military air defense measures, while civil defense is handled by the Ministry of Internal Affairs (MVD). Each European Satellite, Communist China, and North Korea have independent air defense systems modelled after the USSR's and integrated into an over-all Bloc system. We believe that this integration does not include unified command of Bloc air defense forces as such, but there are established channels of communication for the transmission of air defense operational information.

Active Air Defense

19. Within the Soviet Ministry of Defense, the agency with primary responsibility for active air defense of the USSR is PVO *Strany*, literally *Antiair Defense of the Country*, whose commander-in-chief is believed to be a Deputy Minister of Defense. This agency, with headquarters in Moscow, prepares over-all air defense plans involving all appropriate elements of the Soviet armed forces, and is responsible for the integrated training and combat effectiveness of the elements of PVO *Strany*. Throughout much of the USSR, over-all control of the air defense function is exercised by PVO *Strany* through a system of air defense districts, corresponding generally in size and importance to the major industrial and military areas of the USSR and grouped under two major regional headquarters. The principal regional headquarters is at Moscow, and a secondary headquarters responsible for the Far East is probably located at Khabarovsk. Within the Soviet Fleets, Military Districts, and major field commands outside the USSR, there are air defense staffs which coordinate their operations with PVO *Strany*.

20. The forces utilized in the Soviet air defense system include not only those directly associated with PVO *Strany*, but also appropriate forces from other components of the armed forces. Forces directly associated with PVO *Strany* include Fighter Aviation of Antiair Defense (IA PVO), static antiaircraft artillery gun units, static surface-to-air guided missile units, and air observation, warning and communication (VNOS) elements. Forces from other components which are utilized for air defense include tactical fighters, AAA, and VNOS elements in Soviet Military Districts and Groups of Forces; elements of Soviet Fleets including fighter, radar, and visual observer (SNIS) units and naval AAA; as well as elements of the MVD. These various elements are integrated into a functioning air defense system by the various district and higher headquarters of PVO *Strany*. [1]

Passive Defense

21. The passive air defense of Bloc military forces is apparently the responsibility of military commanders, supported by the chemical and other technical services. The civil defense function is directed by civil defense (MPVO) directorates in the various republics of the USSR, under close policy guidance from the MVD in Moscow. MPVO personnel plan, program and enforce local air defense policies and maintain liaison with appropriate elements of the armed forces. They utilize existing civil agencies, such as health and fire departments, to implement passive defense measures. The MPVO is believed to prepare the over-all plans for the civil air defense training and indoctrination programs conducted by DOSAAF, a large paramilitary civilian organization.

[1] For a more detailed description of the operational organization of the Soviet air defense system, as well as its administrative organization, see NIS 26, Section 83, January 1956.

WEAPONS AND EQUIPMENT

Fighter Aircraft

22. Soviet jet fighters have clearly been designed primarily for the interceptor role, exemplified by especially good climb and high altitude capabilities. At present, Bloc fighter forces are equipped with several models of jet interceptors: the FAGOT, five versions of the FRESCO, the FARMER, and two versions of the FLASHLIGHT. While all these are employed as day fighters, FRESCO "D" has a limited all-weather capability and only FLASHLIGHT "A" and "C" are primarily all-weather fighters. All currently operational Bloc jet fighters have combat ceilings estimated on the order of 50,000 feet or higher; combat ceilings of the FRESCO "C" and "D" and FARMER are on the order of 60,000 feet. Without external fuel tanks, FRESCO "C" and "D" are estimated to be capable of climbing to 40,000 feet altitude in 3.7 minutes from take-off. FARMER, the USSR's first supersonic fighter, is probably capable of reaching this altitude in 2.6 minutes. The speed, climb, and altitude capabilities of the heavier FLASHLIGHT all-weather fighters are believed to be somewhat lower than those of the latest operational day fighters.[2]

23. A disadvantage of currently-operational Soviet fighters appears to be the relatively low muzzle velocity and rate of fire of their rather large caliber guns. Older models are equipped with gun sights with manual range input, but more recent models probably employ sights with radar ranging. The FLASHLIGHT is believed to be capable of employing air-to-air unguided rockets or guided missiles.

24. *Airborne Intercept Radar.* There is considerable evidence of the employment of airborne intercept (AI) radar in the FRESCO "D" and FLASHLIGHT aircraft. Against an aircraft of B–47 size, we estimate that the AI radar in the FRESCO "D" has search capabilities of 4–6 nautical miles (n.m.) and track capabilities of 1–2 n.m. at present. The FLASHLIGHT's AI radar is believed to be much more effective, with search and track capabilities of 15–30 and 10–20 n.m. respectively.[3]

25. The performance of known Soviet IFF equipment is considered reliable, but it probably cannot be depended upon to provide secure identification in combat and the IFF system probably has a low traffic-handling capability. Most operational Bloc fighters are equipped with IFF transponders.

Antiaircraft Artillery

26. The principal medium AA gun now employed in Soviet and some Satellite static defenses is the 100 mm. gun, which is employed with a remote control system and off-carriage fire control radar and director. This system is considered capable of continuously pointed fire against high-performance aircraft at medium and high altitudes up to about 35,000 feet. Within the USSR, it probably has entirely replaced the World War II model 85 mm. gun in static defenses, although an improved version of the latter is still used in tactical defense of field forces. Since about 1955, the USSR has also produced limited numbers of a new 122 mm. gun. This weapon has a capability for continuously pointed fire up to 40–45,000 feet, but its slow rate of fire and the relatively long time of flight of its projectile outweigh its altitude advantage.

27. For mobile defense and low altitude coverage, Soviet units are equipped with a 57 mm. automatic AA gun with both on-carriage optical sighting and off-carriage radar fire control equipment. This weapon is believed capable of engaging high-performance aircraft at altitudes up to 15,000 feet under all weather conditions. In Soviet units the 57 mm. AA gun is rapidly replacing the obsolete, manually-operated 37 mm. gun. The USSR also has a family of single, twin, and quadruple barreled 14.5 mm. AA machine guns. While manual operation of these guns would limit tracking and aiming against in-

[2] For detailed estimates of the performance characteristics of Soviet fighter aircraft, see Annex B, Tables 1 and 2.

[3] The AI ranges given assume a tail-cone approach towards the target aircraft. Much greater ranges could be obtained if broadside approaches were made, although it is not known whether the Soviet fire control systems can take advantage of such increased ranges.

dividual targets, they could deliver a high volume of barrage fire for short periods.[4]

28. While we have no direct evidence that the USSR is employing proximity fuzes in its AAA ammunition, their development has been within Soviet capabilities for some time and large quantities could be available at any time during the period of this estimate. It is also probably within Soviet capabilities to have developed an unguided surface-to-air rocket. Some work on such rockets was reportedly performed in the postwar period on the basis of German designs. We have no evidence that such a project was carried to completion, and Soviet interest probably lagged following the successful development of surface-to-air guided missiles.

Guided Missiles[5]

29. In the Moscow area, a system of some 57 surface-to-air guided missile sites with a total of about 3,400 launching pads has been constructed since 1953. The sites are arranged in two concentric rings with radii of approximately 25 and 45 n.m. from the center of the city. All sites are probably now operational. From observations of these sites and their "YOYO" guidance radars, missiles, and other associated facilities, we estimate that the USSR now possesses a surface-to-air system capable of delivering a 600–700 pound nuclear or HE payload to a maximum system altitude of 60,000 feet and horizontal range of 25 n.m.[6] Its guidance system is probably of the command type with a CEP at maximum range of about 190 feet, or possibly a command and semiactive seeker type with a CEP of about 50 feet. We estimate that the guidance system at each site probably has the capability to track and engage 20 targets simultaneously. However, the present guidance system has limited coverage in azimuth, requiring at least 12 sites to give 360° protection around a target with about 50 percent overlap between sites. Present intelligence information gives some indication that the lower limit of its altitude capability may be between 1,000 and 5,000 feet.

30. While there is no direct intelligence to indicate successful Soviet completion of an air-to-air guided missile, our assessment of Soviet capabilities in the field leads us to estimate that by 1955 the USSR could probably have had in operation a system, capable of carrying a 25-pound HE payload to a maximum range of 2–3 n.m., with a CEP of 30 feet. However, a system available by that date would probably have had a simplified guidance system using passive infrared homing, and would therefore be limited to use in tail-cone attacks under conditions of good weather at engagement altitude.

31. Recently acquired intelligence indicates that in 1952 the USSR had under development an air-to-air missile guidance receiver of the beam-rider type. We estimate that if priority development were pursued, the USSR could probably now have an air-to-air system employing this type of guidance in operational use. Such a missile would probably be capable of carrying a 45-pound HE warhead to a maximum range of about 5 n.m., with CEP of about 30 feet. It would be suitable for employment only by all-weather fighters, and the FLASHLIGHT is estimated to be the most likely present carrier.

Early Warning, Ground Controlled Intercept, and Fire Control Radar

32. Accurate evaluation of radar detection capability has proved extremely difficult even where all technical factors are known. The lack of much significant data on Soviet radars, and the wide variation in circumstances of

[4] For detailed estimates of Soviet AAA characteristics, see Annex B, Table 3.

[5] For detailed descriptions of estimated Soviet surface-to-air and air-to-air guided missiles, see Annex B, Table 4.

[6] This range represents our estimate of the present capability of the system. It probably had a maximum horizontal range of 20 n.m. when it first became operational in 1955. For a detailed description of this system, see NIE 11-5-57, "Soviet Capabilities and Probable Programs in the Guided Missile Field," 12 March 1957, paragraphs 56–62. For appropriate nuclear warhead capabilities, see NIE 11-2-57, Part I, "Soviet Atomic Energy Program," dated 7 May 1957, limited distribution.

employment, requires the use of rather wide brackets in estimating detection ranges. In addition, in order more clearly to define the nature of the estimates in the following paragraphs, we set forth the assumptions under which they were made:

a. That the aircraft will present less than maximum echo area to the radar.

b. That standard radar propagation conditions will exist.

c. That because of various degrading factors encountered under operational conditions, the radar will achieve significantly less than theoretical maximum ranges.

d. That the target aircraft is above the radar horizon.[7]

33. *Early Warning Radar Ranges.* While many types of radars are employed for long-range early warning in the Bloc, those in most widespread use at present are the TOKEN, GAGE, DUMBO, and KNIFEREST. Under the assumptions listed above, we estimate that against currently-operational Western bomber and fighter-bomber aircraft, approaching at altitudes between the radar horizon and their combat ceilings, reliable detection by Bloc radars will probably occur within the following range brackets:

Radar	B–47 Size Aircraft	F–86 Size Aircraft
TOKEN	80–180 n.m.	70–100 n.m.
GAGE	about 160 n.m.	100–160 n.m.
DUMBO and KNIFEREST	50–140 n.m.	35–85 n.m.

34. *GCI Radar Ranges.* The significant Bloc GCI radars are considered to be the TOKEN, either alone or with ROCK CAKE heightfinder, and the GAGE with PATTYCAKE heightfinder. DUMBO and KNIFEREST are occasionally used for GCI work, but their performance is inadequate. Assuming the same conditions as in the case of the early warning radars given above, we estimate that reliable GCI operations could begin somewhere within the following range brackets:

Radar	B–47 Size Aircraft	F–86 Size Aircraft
TOKEN	50–110 n.m.	40–70 n.m.
GAGE/PATTYCAKE	70–90 n.m.	40–60 n.m.
TOKEN/ROCK CAKE	80–110 n.m.	50–70 n.m.

GCI positioning is dependent upon the ability to obtain accurate altitude information. Available intelligence does not permit an accurate assessment of the heightfinding capabilities of these radars, although the TOKEN apparently has rather poor heightfinding capabilities for altitudes above 35,000 feet. The recent appearance of new heightfinders indicates that the USSR is attempting to correct this inadequacy. Actual control of interception can be accomplished only within the range at which the radar can track the Bloc fighter. The use of transponder beacons in interceptors would permit them to be tracked to approximately the GCI detection ranges for bombers, but we have no firm evidence that the Bloc is employing IFF equipment for this purpose. We estimate that the traffic-handling capacity of any one Soviet GCI site is limited to six simultaneous interceptions under close control.

35. *AAA Fire Control Radar.* The WHIFF fire control radar, a Soviet version of the US SCR–584, is in general use with Bloc AAA units, although a newer set, the FIRECAN, has appeared recently. Other models of native design are believed to be available in limited quantities in Hungary and possibly Czechoslovakia. Current Bloc fire control radars have effective ranges considerably in excess of the ranges of the guns with which they are employed; e.g., 30–50 n.m. in the case of the WHIFF. Accuracy is estimated at plus or minus 1.0–1.5 mils in azimuth and elevation and plus or minus 15 yards in range.

Other Electronic Equipment

36. *Communications.* Soviet electronics research and development establishments are

[7] The radar horizon is directly analogous to the optical horizon below which objects cannot be seen due to the curvature of the earth. Thus for any given heights of radar and target there is a maximum range beyond which detection will not occur under standard propagation conditions. To illustrate, for a radar sited at sea level in an area free of terrain obstructions, the radar horizon will be at about 170 n.m. against a target at 20,000 ft. altitude, but will decrease to about 85 n.m. against a target at 5,000 ft. altitude.

capable of providing communications equipment equal in quality to that of the West. Until recently, the standard air-to-air and air-to-ground communications equipment for Soviet fighters was an improved version of a World War II high frequency (HF) radio system, supplemented after 1952 by four-channel very high frequency (VHF) equipment. There are indications that a ten-channel VHF system may now be available for some Soviet tactical aircraft. There is as yet no indication of the employment of ultra-high frequency (UHF) systems for air-to-air and air-to-ground communications.

37. For ground-to-ground communications, the USSR employs all standard systems for both military and civil defense needs. Land-lines, high-speed radio-telegraph, and voice radio communications network are in widespread use in European USSR and the Satellites, becoming gradually less dense in the northern and eastern areas of the USSR. During the past few years, the USSR has also been using UHF relay equipment which provides up to 16 voice or 48 teletypewriter channels. In East Germany, this type of equipment is probably functioning in an air warning network linked to other Bloc countries.

38. *Automatic Computation and Data Handling Equipment.* Air defense data handling capabilities would be greatly increased by employing any of a variety of data link systems known to be available to the USSR, including television link equipment which could be employed to transmit data very rapidly or even to transmit pictures of complete status boards. The USSR is known to have developed high-speed computers, which could play an important role in these systems. With East German assistance, the USSR is also developing automatic data handling devices suitable for air defense purposes. We have no evidence that the above types of equipment are in current use in the Bloc air defense system.

39. *Radio Navigation Equipment.* For the major portion of its air navigation, including approach and landing, the Bloc relies upon radio homing aids. Ground direction-finding sets and omnibeacons are now in use, and we believe that GCA landing aids are being installed at key fighter fields. There is evidence that the development of more precise navigation and landing aids, including distance-measuring equipment, is under way.

40. *Electronic Countermeasures.* We believe that at present the USSR has an appreciable capability for jamming Western bombing and navigational radars at frequencies up to 10,000 mc/s and possibly higher, and especially for jamming at the lower frequencies normally used in Western long-range radio communications. Research is now being conducted on magnetrons and probably traveling wave tubes, suitable for jamming in the microwave frequencies, but we know of no operational equipment utilizing these tubes. Known types of Soviet radio and radar equipment, including acquisition and target-tracking radars, are vulnerable to jamming. The vulnerability of present Bloc radars is increased by the concentration of their frequencies, predominately in the three narrow bands of 75–85 mc/s, 2610–3100 mc/s, and 9200–9500 mc/s. The USSR is aware of the effectiveness of countermeasures against radar, and is capable of developing devices which would render its radars less vulnerable to jamming and spoofing. We are unable to estimate the extent to which such devices have been developed or are presently incorporated into operational equipment.

41. Bloc passive electronic intercept stations are estimated to be capable of monitoring Western electromagnetic signals through the entire frequency spectrum from HF up through 10,000 mc/s. A number of passive intercept stations with this estimated capability have been identified along the borders of East Germany and Poland. There is also evidence that airborne and shipborne electronic reconnaissance is being conducted by the USSR.

STRENGTH AND DEPLOYMENT [8]

42. The large quantities of air defense weapons available to the Bloc are deployed pri-

[8] For details of the estimated strength and deployment of Bloc air defense equipment, see Annex B, Tables 5–7, and Annex C, Map 1.

marily in defense of key Soviet static targets and military forces, with proportionately much smaller quantities allocated to other Bloc nations. Total Bloc jet fighter strength for mid-1957 is estimated at about 14,000 aircraft, of which more than 10,000 are in Soviet units, about 1,900 are in European Satellite units, and about 1,900 are in Asiatic Communist units. Operational Bloc AA guns are estimated to total nearly 15,000 medium weapons and nearly 19,000 light weapons, of which almost 75 percent are in Soviet units. With regard to the quality of weapons provided, the USSR has likewise followed a policy of satisfying the needs of its own units, especially those within the USSR, before those of other Bloc nations. For example, while approximately 13 percent of total Soviet fighter strength is now believed to comprise fighters with at least limited all-weather capabilities, other Bloc nations have been supplied with these aircraft in only nominal quantities and none are believed to have received FLASHLIGHTs. The 100 mm AA gun, which has been issued to Soviet units since 1950, has been issued in small quantities to certain of the East European Satellites and to Communist China within the past two years. With regard to early warning radar, however, high quality equipment has been installed on the Satellite borders to provide additional warning time for key Soviet targets.

43. Fighter aircraft of the USSR are organized into about 320 regiments. Of these, about 115 are in IA PVO with air defense as their sole mission, while about 140 are in tactical aviation and about 65 in naval aviation, with air defense as one of their missions. In addition, there are 53 fighter regiments in European Satellite forces and 58 in North Korean and Chinese Communist forces. The USSR has replaced the piston aircraft in its ground attack regiments with jet fighter types. There is evidence that upon their re-equipment these regiments initiated training in interceptor operations, and they are now considered as tactical fighter regiments, capable of performing both ground support and air defense missions. Our estimate of the number of Soviet aircraft and regiments available for air defense has been increased considerably as a result of this development, but we do not believe it reflects any continuing upward trend in the total numerical strength of the Soviet fighter establishment. At present, the bulk of operational Soviet fighters are FRESCOs; other Bloc fighter forces are now almost completely jet-equipped, although largely with older types.

44. The areas of greatest concentration of Bloc air defense weapons and associated equipment include that portion of European USSR from the Kola Peninsula to the Caspian Sea, East Germany, Poland, Czechoslovakia, and the Maritime and Sakhalin areas of the Soviet Far East. Throughout most of these areas, aircraft penetrating Bloc air space would be within range of Soviet fighters at all times. The heaviest concentrations of IA PVO fighters are in the Moscow, Baku, and Leningrad areas, which account for over two-thirds of estimated IA PVO strength. Somewhat lesser concentrations are elsewhere in European USSR and in the Sverdlovsk, Tashkent, Novosibirsk, Lake Baikal and Khabarovsk areas. Critical peripheral areas in Europe, the Black Sea Coast, and the Soviet Far East are defended by significant tactical and naval defense forces.

45. Moscow is by far the most heavily defended area in the Bloc. Of the estimated total of 3,800 IA PVO jet fighters, nearly 1,300, or about one-third are based within a radius of 250 n.m. from Moscow, with the greatest concentration believed to be on the western approaches to the city. Moscow is the only Bloc target now known to be protected by a surface-to-air guided missile system. The Moscow missile sites are deployed so as to provide over-lapping coverage of targets approaching in any quadrant, between about 25 n.m. and 70 n.m. from the center of the city. Still closer to the city are AAA defenses which may total more than 700 guns, the bulk of them 100 mm guns, but including some 122 mm and 57 mm guns. These defenses are served by high concentrations of radar sites, fire control, and communications equipment.

46. Areas of significantly less dense air defense concentration than those described in

paragraph 44 include Albania, Bulgaria, Hungary, Rumania, most of central and northeast Siberia, and the interior of China. The areas within 200 n.m. of the coast of China and North Korea are well-equipped with air defense forces but are severely limited in all-weather capability. Portions of the Chukotski Peninsula and the Arctic littoral have some air defense capabilities.

47. We estimate that there are at present in excess of 500 prime operational early warning and GCI radar sites in the Bloc, employing long-range early warning and heightfinder radar types in various combinations. These sites are supplemented by approximately 1,000 gap-filler radars. Early warning radars are disposed around a major portion of the Bloc's borders. Coverage of a penetrating target by three or more radars simultaneously can probably be achieved throughout most of European USSR, the Satellites, and the Pacific coastal areas. Gaps in peripheral early warning radar coverage appear in southwestern China and the Soviet Arctic coast between Dikson and the Chukotski, although the latter may reflect gaps in intelligence.[9]

OTHER FACTORS AFFECTING AIR DEFENSE CAPABILITIES

Air Facilities

48. Air defense requirements have played a significant role in determining the priority and scope of airfield development in the Bloc during the past few years. Construction of new air defense bases and improvement of existing ones has been undertaken to provide greater flexibility for both current and future deployment of Bloc fighter forces. The emphasis has been on the construction of long, permanent surface runways with well-developed overruns. Whereas early runway construction at jet fighter fields was generally to lengths of 5,000–6,600 feet, the more recently built runways frequently have been up to 7,200 feet in length. A summary of the 544 airfields in the Bloc with long, permanent surface runways is given in the table below. Approximately 300 of these fields are currently being used for air defense operations.

Minimum Runway Lengths (feet) *

Area	9,000	8,000	7,000	6,000	5,000
USSR	8	50	20	175	45
European Satellites	2	47	46	33	2
Asiatic Comm. Nations	0	8	19	59	30
	10	105	85	267	77

* This table, referring to runway lengths only, is not to be taken as a measure of the capability of the fields to handle sustained military operations or operations under all weather conditions.

In addition, there are about 400 Bloc airfields with runways over 4,000 feet in length which could be utilized for fighter operations under reduced safety margins.

49. The geographic distribution of these airfields is generally consistent with the areas of greatest and least air defense concentration described in paragraphs 44–46 above. However, airfield development work has been underway in certain of the less well-defended areas. Development of the airfield network in Southern China opposite Formosa has been in progress for the past three years and is continuing. Considerable improvement in basing facilities has occurred in the Soviet Arctic since 1952, as the result of a widespread construction program. Nevertheless, the number of airfields in the Arctic littoral suitable for air defense operations is still so small that the extent of fighter operations in that area would be governed by the limiting conditions imposed by the utilization of substandard bases.

Logistic Support and Maintenance

50. We estimate that the Soviet supply system, transportation network, and local storage facilities are adequate to meet immediate air defense needs in many areas, since most anti-aircraft installations, airfields, and radar stations are located adjacent to populated areas and/or main transportation and communications lines. There are indications that maintenance procedures are exacting and care-

[9] For estimated Bloc radar coverage, see Annex C, Map 2.

fully supervised and maintenance of equipment is believed to be good to excellent. Our evidence on Soviet electronic equipment indicates that it is generally reliable and well-maintained.

51. *Jet Fuel.* Although we lack information on the exact location of fuel storage points in many areas, and on the amount of fuel actually stored, we estimate that operational Bloc airfields have an average capacity to store sufficient fuel for 8–10 days sustained combat operations. Operational Soviet jet fighters are flown an average of only 10–15 hours per month, and we believe that this is due in part to a policy of allocating considerable quantities of fuel to reserve storage, and in some areas to transportation deficiencies.

52. *Jet Serviceability.* We estimate that for present Soviet jet fighters, an immediate serviceability rate[10] on the order of 70 percent could be achieved without special preparations. Following a 5-10-day standdown, this serviceability rate could be temporarily increased to about 80–90 percent for a period of 7–14 days. Thereafter, serviceability rates could be maintained at about 70 percent for a period of four to six months under sustained combat conditions, and would then decline to 40–50 percent. Under extreme weather conditions and in areas not served by adequate transportation, such as in the Arctic, the above serviceability rates would be reduced.

Personnel and Training

53. We estimate that at present there are in the Bloc approximately 1.4 million military personnel engaged in active air defense functions, either as their sole mission or as one of their missions. Of these, more than 900,000 are Soviet personnel.[11] In general, we believe their technical skills and training to be adequate, although we have insufficient evidence to permit an assessment of the training of certain categories of personnel, notably those in the air warning services. Training standards in the Satellites and Asiatic Communist nations are generally lower than those in the USSR. Throughout the Bloc, however, personnel requirements are probably fulfilled on a priority basis in accordance with the emphasis placed on air defense. The rate of attrition due to personnel turnover is believed to be low.

54. In the USSR there are about 24 flight training schools for fighter pilots, which probably graduate a total of about 2,400 pilots per year. Fighter pilots are believed to acquire about 145 hours' flying time before reporting to an operational unit; about 45 hours as pilot candidates in DOSAAF and about 100 hours as student pilots in military flying schools. Until recently, this training was in trainer-type aircraft, but at present Soviet training establishments have an estimated 1,100 jet fighter aircraft of tactical types, which are being used for pre-operational training. Students receive little gunnery or night-flying training. We believe there is no instrument school as such for the training of fighter pilots in the Bloc.

55. Once a Soviet fighter pilot has been assigned to an operational unit, he probably averages only about 7–10 hours' flying time per month.[12] The details of the current operational training program of the IA PVO are not known. In 1950, training goals were to acquire fully the technique of interception and destruction of large hostile air formations, but these goals probably now include interception and destruction of single aircraft and small formations. Instrument training is conducted in operational units. Night flying has increased considerably and the standards have probably been raised, but we believe they are probably below US standards.

56. The training of Soviet AAA officers is conducted in several basic and specialist schools, including an AAA academy which holds advanced courses for battery and higher level commanders. Training for enlisted men is conducted in unit schools. The annual training cycle for AAA units includes range firing,

[10] A "serviceable" aircraft is one which is fully prepared to perform its assigned combat mission.

[11] For a breakdown by area and function, see Annex B, Table 8.

[12] US fighter pilots average 20–30 hours per month.

field firing exercises, and combined training and maneuvers. Combat firing exercises are conducted twice yearly, and jet aircraft are known to have been used to tow targets for such exercises. Combat alerts are conducted throughout the year. During these alerts, units in garrisons must be manned and in regimental march formation in less than two hours. When on the march, automatic weapons crews must be able to fire within 10 seconds from the wheels or within 40 seconds by pulling off the road and putting the gun into firing position. Medium gun crews are required to be able to deliver fire within 50 seconds.

Command and Coordination

57. The size and complexity of the Bloc's air defense organization, together with the vast area over which it must function, has presented the USSR with a formidable control and coordination problem. Within the Soviet PVO organization alone there are a large number of control centers at various echelons, including about 35 PVO district control centers and 80–90 subdistrict control centers and associated filter centers for analyzing and transmitting radar and visual warning information. In addition, control centers probably exist at each fighter division headquarters and at various AAA organizational levels. Over-all coordination of the operations of the various air defense components is accomplished through a communications system which, in many areas, probably includes parallel land-line and radio links between early warning sites, GCI sites, and control centers. In those areas where land-line or point-to-point radio facilities are lacking, the traffic-handling capacity of the system is probably limited to about five simultaneous raids at one reporting site.

58. It is probable that early warning sites channel their reports through the subdistrict filter center to the district control centers. Coordination between local air defense forces is probably accomplished on an information basis at the subdistrict level, but major command decisions probably occur at the district level. At the same time, information is probably passed laterally between district headquarters and vertically to Moscow or Khabarovsk. In a local situation, the fighter division commander probably has the authority to commit as much as the alert flight, but in a general situation, a decision to commit larger forces probably would be made by a higher echelon.

PASSIVE DEFENSE

59. The USSR has devoted increasing attention to the passive defense of both military and civil personnel and facilities since the Korean War period. Soviet military and civilian passive defense programs give attention to the problems of defense against nuclear, biological, and chemical warfare. These programs are participated in by large segments of both the civilian and military populations. While selected control elements of the government may now have up-to-date protection available to them, we believe that the general population is inadequately prepared against large-scale nuclear attack.

60. *Camouflage and Deception.* Bloc ground forces are accustomed to night operations, and camouflage of field forces and facilities during maneuvers is routine in their tactical doctrine and training. It must be assumed that the USSR is aware of the techniques used by the Germans during World War II, such as the construction or simulation through radar camouflage of false cities, factories, etc. However, to date there has been no evidence of such deceptive camouflage.

61. *Dispersal.* A trend toward somewhat greater dispersal has been evident in Soviet military forces in recent years. Revised ground force tactical doctrine stresses the need to present a concentrated target for as short a time as possible, emphasizing the rapid concentration of forces, timely seizure of objectives, and rapid redispersal. The Soviet navy is believed to be engaged in some programs which will permit greater dispersal, including the development of additional base facilities and the construction of mobile support units such as submarine tenders and fleet tankers. Current Soviet practice is to base one to two air regiments at a field, and

parking and revetment areas are generally located relatively close to the landing strips. However, dispersed parking areas are now being added at some airfields. The estimated availability of both permanent and natural surface airfields is such that no more than one regiment would probably be based at any one field in wartime.

62. We have no evidence of a specific Soviet program for the dispersal of governmental and industrial installations. Some dispersal is occurring naturally as a result of the industralization of additional areas. The recently-announced decentralization of administrative control may have some bonus effect from a passive defense point of view, although present Soviet decentralization plans apparently do not include the most critical defense industries. To date there has been no public mention of evacuation or dispersal of the general population in the event of war.

63. *Underground Installations and Shelters.* Underground military command posts and filter centers have been reported in Hungary, Bulgaria, and East Germany, and we assume that such installations exist in major defense centers elsewhere in the Bloc. Some airfields are equipped with underground storage and repair space. Our information is insufficient to determine the extent of these facilities, but they are probably not widespread.

64. The incorporation of air raid shelters into newly-constructed buildings began in the USSR in the late 1940's and became a major national program at the time of the Korean War. In most masonry apartment dwellings built since 1951, it has been standard practice to include cellar shelters designed to be gasproof and to withstand complete collapse of the building. This program probably now affords some degree of shelter for roughly one-sixth of the urban population of the USSR, and this proportion will probably rise to roughly one-third by the end of 1960. In addition, there are shelters in factories and public buildings.

65. Most existing shelters were not designed for protection from high-yield nuclear weapons. There are indications, however, that the newer building shelters are of heavier construction. So far as is known, there has been no new construction of large underground shelters separated from buildings. However, the Moscow and Leningrad subways are available for use as shelters, and Vladivostok, Baku, and Sevastopol have retained and improved elaborate tunnel systems constructed during World War II.

66 *Training.* Passive defense against air attack is included in training programs throughout the Soviet military forces. Field manuals and pamphlets published for troop issue include defensive measures for nuclear, biological, and chemical warfare. Soviet maneuvers have included defensive tactics against such weapons. Troop training stresses proper use of protective equipment, and field decontamination procedures, as well as discipline with regard to contaminated areas, water, and foodstuffs. The current issue gas mask is believed to afford adequate protection against inhalation of known BW and CW agents.

67. Civil defense training in the USSR has been intensified since 1948 and especially since 1953, when recruitment in the civilian paramilitary organization (DOSAAF) was stepped up and air and chemical defense courses were made a compulsory part of DOSAAF training.[13] These courses, probably in conformity with standards set by the MPVO, embrace a general knowledge of civil defense, including alarm signals, types of attack, gas defense and decontamination, first aid, and fire fighting measures. Within the past several years, Soviet authorities have released a limited amount of information on the effects of nuclear weapons, and elementary nuclear and biological defense instruction has been added to the DOSAAF training program. Field demonstrations are conducted and air raid drills are prescribed, but there is no evidence that drills have been conducted on a full-scale, city-wide basis.

[13] DOSAAF, whose total membership is estimated to be over 20 millions, has primary units charged with organizing "self defense" groups in factories, institutions, collective and state farms, machine tractor stations, schools, and dwelling units throughout the USSR.

68. In April 1957, the USSR publicized a civil defense movie entitled *Antiatomic Defense of the Population.* This is the first time a publicly-released Soviet film has pictured a nuclear explosion. Widespread dissemination of the film was urged.

PROBABLE FUTURE DEVELOPMENT OF THE SOVIET AIR DEFENSE SYSTEM

69. In estimating the future development of the Bloc air defense system to 1962 we have taken a number of considerations into account: (a) the intelligence available on current organization, weapons, and equipment, which provides a base line from which to estimate the possible future design and scale of the system; (b) the requirements which we believe the Soviet leaders would probably adopt for an air defense system in the light of their estimate of the probable threat posed by Western aircraft and missile capabilities; (c) intelligence available on current Bloc research and development programs and our estimate of the Bloc's scientific and technical capabilities to develop new weapons and equipment to meet future requirements; (d) the economic resources available and the cost considerations the Soviet leaders would have to take into account in building their future air defense system. These considerations, taken together, provide the basis for our estimate of future Bloc air defense programs where direct evidence is still lacking. This estimate is also based on our belief that the Soviet leaders will continue to give a high priority to air defense.

SOVIET ESTIMATE OF THE AIR AND MISSILE THREAT TO THE BLOC

70. On the basis of information we believe they can acquire by overt and covert means, Soviet planners can probably estimate fairly accurately the general performance characteristics, quantities, and world-wide disposition of the weapons and delivery systems the US and its Allies could presently employ against the Bloc. Within reasonable limits, they can probably anticipate the dates at which new US and Allied attack capabilities will appear. They recognize that the Bloc is geographically surrounded by Western air power and that US heavy bombers and US and Allied medium bombers, using inflight refueling as neccesary, could reach any target in the Bloc on two-way missions from existing overseas or continental US bases. In addition, they are aware that many of the important target areas in the Bloc can be reached by Western light bombers, fighter bombers, and carrier aircraft operating from widely separated bases. The great area of uncertainty for the Soviet planners undoubtedly is the planned employment of Western weapon systems. Soviet planners almost certainly estimate that in the event of general war during the period of this estimate, the US and its Allies would possess great flexibility in scale, direction, and tactics of attack.

71. The USSR probably recognizes that at present the gravest threat posed to the Bloc is that of nuclear attack by manned bomber, fighter-bomber, and naval attack aircraft employing high and medium altitude horizontal bombing and low altitude toss or loft bombing. Of the more than 8,800 US and Allied aircraft capable of striking the Bloc, the great majority are capable of attacking between very low altitudes and about 45,000 feet, at speeds of 400–500 knots. A small number of these aircraft have better performance capabilities; Soviet planners would probably anticipate attacks in peripheral areas by jet fighter-bombers capable of altitudes up to about 50,000 feet and speeds up to 600 knots. A small part of the current threat would be guided missiles, including short range ballistic missiles and ground and naval launched subsonic cruise-type missiles with altitudes up to about 45,000 feet and ranges up to about 800 n.m.

72. The USSR would probably estimate that in the 1960–62 time period, US and Allied capabilities would include delivery vehicles reaching higher speeds and altitudes. While the capabilities of most attacking aircraft would probably be within the limits set forth in the preceding paragraph, Soviet planners would probably anticipate that by 1962 several hundred would have considerably greater altitude and speed capabilities, ranging up to about

60,000 feet and about 1,200 knots. While they would probably expect some decrease in the total numbers of Western manned aircraft during the period, they would also expect a marked increase in both the numbers and types of guided missiles. They would probably estimate Western missile capabilities for 1962 to include several thousand long- and medium-range ground and naval launched cruise-type missiles and decoys, including some with supersonic speeds and altitudes up to 70,000 feet; large numbers of short-range ballistic missiles; large numbers of air-to-surface missiles and decoys with ranges of 100 n.m. and greater; and small numbers of IRBMs and ICBMs.

73. Soviet planners would have to assume that high-yield nuclear payloads are now incorporated into the US weapons systems which could be employed against the Bloc, and that there will be a continuing increase in the maximum yield capabilities, versatility, efficiency, and numbers of US stockpile weapons. In addition, they would expect continued improvement in US and Allied weapon delivery capabilities under all weather conditions, increased capabilities of attacking aircraft to defend themselves against interception, increased employment and sophistication of electronic countermeasures and penetration aids, and further increases in US inflight refueling capabilities.

74. Soviet planners almost certainly recognize that, while a successful defense against sustained high explosive attack can be achieved by imposing a high rate of attrition on attacking forces, attack employing high-yield nuclear weapons requires that their air defense system achieve a high probability of denying access to vital targets. The present defenses of Moscow suggest that a concept of denial of access has been adopted for the Soviet capital. In the light of expected increases in the capabilities of Western delivery vehicles, especially in speed and altitude, and in Western weapon yields, Soviet planners probably consider that the size of the target danger zone (i.e., the area around any given Bloc target into which denial of penetration must be sought) will increase as the period advances. Thus, their programs for the development and deployment of Bloc air defense equipment will probably aim to achieve successful interception and kill at increasing distances from vital Bloc targets. Moreover, Soviet planners probably recognize that their air defense system must be capable of protecting Bloc air defense bases and related ground installations in order to insure the sustained defense of vital targets.

75. Soviet planners will have to exercise a fine degree of judgment in evaluating weapon system utility as new offensive and defensive systems are developed by both sides in a period of rapidly-changing weapon technology. In many cases, choices will not be clear-cut and complementary air defense weapon programs will be justified. Moreover, during this period potential Western attacking forces will comprise a wide variety of weapon systems, of which the bulk will be existing or improved models of currently-operational aircraft and missile types and a small percentage will be IRBMs and ICBMs. In view of present trends in Bloc air defenses and the wide diversity of Western attack capabilities and methods, we estimate that during the time period considered in this estimate the Bloc will continue to maintain a mixed force of air defense weapon systems.

TRENDS IN INTERCEPTION AND KILL CAPABILITIES

Fighter Aircraft [14]

76. In order to oppose the highest-performance Western aircraft, the Bloc will need to have in operation by about 1960 fighters with speed capabilities of about 1,200 knots and combat ceilings of about 60,000 feet. In addition, Bloc fighters will need to be provided with improved AI gear, armament, fire control, and communications equipment, but at the same time must achieve high rates of climb to altitude. Prototype day and all-weather fighters displayed by the USSR in June 1956 appeared to emphasize high performance characteristics at the expense of rel-

[14] For detailed estimates of performance characteristics of Soviet fighters, see Annex B, Tables 1 and 2.

atively short combat radii. We estimate that new Soviet fighters will probably be introduced into operational units as follows: in 1957, the FACEPLATE day fighter, which may be entering production now; in 1958, the FITTER day fighter, and in 1958, 1959, and 1962, new all-weather fighters. Of these all-weather fighters, the 1959 model will probably be an improved version of the FISHPOT prototype, but no known prototypes can be associated with the new all-weather fighters estimated for 1958 and 1962.

77. Based on an analysis of the prototypes observed and on estimated Soviet capabilities in aircraft development, we estimate that all these new fighters will have combat ceilings of at least 60,000 feet, will be supersonic, and will be capable of climbing to 40,000 feet altitude in four minutes or less.[15] Maximum speeds of about 1,200 knots will probably be achieved by day fighters in 1958 and by all-weather fighters in 1959. The 1962 all-weather fighter will probably be capable of operating at altitudes up to 67,000 feet and of climbing to 40,000 feet in less than two minutes.[16] Most of the new fighters will probably be capable of employing guided missiles, unguided rockets, improved guns, or combination armaments. We estimate that the effective range of operational AI radar will not increase significantly over that now estimated for the FLASHLIGHT (see para. 24), but that equipment performance will be improved.

78. We believe that the primary emphasis in the USSR's present fighter programs is on introducing fighters with improved performance characteristics, rather than on increasing the numerical strength of the Soviet fighter force. During the period of the estimate, the number of all-weather fighters in Soviet units will probably increase rapidly, but the USSR will probably also consider the day fighter to be of continuing value because of its comparatively greater reliability, ease of maintenance, and lower cost, as well as its capability for dual employment in air defense and tactical support missions. On the basis of probable Soviet requirements and production capabilities, we estimate that by mid-1962 the Soviet fighter force might have approximately 60 percent of its strength in all-weather fighters.

79. With regard to the over-all number of manned interceptors to be maintained in Soviet operational units, Soviet planners probably consider that as suitable surface-to-air missiles and associated equipment become available in quantity, the number of fighters required for air defense missions will decrease. Other factors which might contribute to a Soviet decision to decrease the USSR's numerical strength in manned interceptors include the probable increase in the destructive power of individual interceptors as improved armament and fire control systems become available, and the increased demands on industrial capacity resulting from the advent of more complex fighters. At present, we can estimate only that the USSR will probably not increase its present numerical fighter strength, and that a decision will probably be made to begin cutting it back some time late in the period of this estimate. On this basis, we hold estimated Soviet fighter strength constant at about 10,000 aircraft through mid-1962, recognizing that the timing of the Soviet decision will depend largely on the USSR's actual progress in the guided missile field.

80. European Satellite and Asiatic Communist fighter forces will probably continue to increase in numerical strength during the period. Our future estimates are based primarily on recent evidence that increases have been made in both the authorized and actual strengths of some fighter regiments in the Satellites and China. There is also evidence that the Chinese Communists are now adding a third regiment per fighter division. We believe that these developments may represent

[15] Climb to altitudes nearer their combat ceilings, using military power, would require considerably longer time; for example, at military power, the FACEPLATE would require 6.3 minutes to climb to 50,000 feet, as compared with 3.8 minutes to 40,000 feet. On the other hand, at maximum power, FACEPLATE's time to climb to 50,000 feet would be only 3.4 minutes, but with a resultant sacrifice in combat radius.

[16] All characteristics given are those estimated for clean configurations. If rockets or missiles were mounted externally, or if external fuel tanks were employed to increase combat radii, performance would be significantly reduced.

continuing trends. In addition, it is probable that Satellite ground attack regiments will convert to tactical jet fighter regiments with dual mission, following the recent Soviet pattern. The bulk of any increase in fighter strength in these countries will comprise older models retired from Soviet forces as the USSR introduces higher performance aircraft into its own units. [17]

81. The geographic distribution of Bloc fighters will probably change somewhat during the period, with more fighters becoming available to the presently less well-defended areas. In the USSR, as surface-to-air missiles are introduced into the defenses of critical target areas, fighter forces near these areas will probably be deployed outward in order to permit the more effective employment of both fighters and missiles.

Guided Missiles

82. Soviet planners probably believe that guided missile systems, particularly surface-to-air systems, offer the greatest potential for denying final penetration to high-value targets by aircraft and cruise-type missiles. Moreover, of present weapon systems, the surface-to-air missile alone has the potential for development into an antiballistic missile system. We therefore believe the USSR will make a strenuous effort to develop, produce, and deploy surface-to-air missile systems.

83. To oppose high altitude attack by US and Allied aircraft and cruise-type missiles (including air-to-surface missiles), the USSR would require improved surface-to-air systems during the period of this estimate. By 1962, effective altitudes of about 70,000 feet and horizontal ranges of 50–100 n.m. would probably be required. On the basis of limited information on Soviet development programs and our assessment of the state of the guided missile art in the USSR, we estimate that the USSR is probably capable of developing and placing in operation during the 1959–1961 time period surface-to-air systems which could deliver nuclear or HE warheads to these horizontal ranges and to considerably greater altitudes. [18] Both land-based and shipborne systems will probably be developed.

84. Moreover, we estimate that Soviet planners would probably have been interested in developing a guidance system capable of 360° traverse for static and mobile employment with the 60,000 ft/25 n.m. missiles. Considering technically feasible alternatives for surface-to-air missile guidance systems and the relative cost per unit of various solutions to the 360° guidance problem, we estimate that the USSR would probably have developed a command-type system permitting the use of fire-units considerably smaller than those at Moscow, but with a lower traffic-handling capability per guidance radar. We estimate that such a system could be operational in 1957.

85. The low altitude limit of the current Moscow system will probably remain about the same as at present, and low-altitude coverage will probably be required to supplement both this system and the more advanced high-altitude systems. For defense of static targets, field forces, and naval vessels, the USSR now requires low-altitude surface-to-air systems capable of interception at horizontal ranges out to about 20 n.m., increasing to about 35 n.m., as the period advances. We estimate that a low-altitude system capable of carrying an HE warhead could probably be placed in operation in 1958, [19] but that its maximum horizontal range during the period to 1962 would probably be about 15 n.m.

86. To improve the kill capabilities of Bloc fighters, improved all-weather air-to-air guided missiles will probably be developed. We estimate that in 1958 the USSR could probably have in operation an all-weather missile

[17] For numerical estimates of future Bloc fighter strength, see Annex B, Table 5.

[18] For detailed estimates of missile performance characteristics, see Annex B, Table 4. For appropriate nuclear warhead capabilities, see NIE 11-2-57, Part I, "Soviet Atomic Energy Program," dated 7 May 1957, limited distribution.

[19] It is the view of the Assistant Chief of Staff, Intelligence, USAF, that the USSR would be unlikely to have an effective all-weather, land-based, low altitude surface-to-air missile system in operational use prior to 1960–1961. See his footnote to NIE 11-5-57, paragraph 62.

system capable of delivering a 50-pound HE warhead to a maximum range of about 5 n.m., and that a system capable of delivering a nuclear or HE warhead to a maximum range of 15–20 n.m. if launched at 60,000 feet could probably be available in 1960.

87. Although we have little knowledge of Soviet interest or activity in the field of unguided air-to-air rockets, we estimate that the USSR could employ them with interceptors during the period. Unguided air-to-air rockets with HE warheads could now be available; the USSR probably has the technical capability to equip a large-caliber unguided air-to-air rocket with a nuclear warhead in 1958–1959.

88. The required performance characteristics of an antiballistic missile system are not fully known. Considering the necessity to achieve a kill before the missile enters the target danger zone, Soviet planners might establish antimissile system performance requirements for initial interception at altitudes up to 300,000 feet and horizontal ranges out to 75 n.m., with much greater system detection and tracking ranges required. While an antimissile development program will almost certainly be pursued with great vigor by the USSR, we do not believe it will be able to place in operation a system capable of successfully intercepting ballistic missiles during the period of this estimate.

89. We estimate that series production of surface-to-air guided missiles is now underway, and that the USSR will probably produce such missiles in large quantities. In the Moscow area there are four and possibly six factory-type facilities, at present in different stages of completion, which appear to be partial fabrication and final assembly plants for surface-to-air missiles. In addition, there is some evidence that surface-to-air launching sites are under construction near Leningrad, and there have been unconfirmed reports of missile sites at a few other locations. Other than the above, we have no current intelligence on Soviet programs for the production or operational employment of air defense missile systems. Considering air defense missiles as a high-priority element in an over-all Soviet missile program, we believe that the USSR might produce, by mid-1962, sufficient missiles and guidance equipment to accomplish an operational program about as follows: (a) equip about 150 static and mobile missile units with ground-launched missiles of the Moscow type; (b) equip about 170 static and mobile missile units with higher-altitude, longer-range missiles; (c) equip about 175 static and mobile missile units [20] with low-altitude missiles; (d) equip about 10 cruisers and 16 destroyers with surface-to-air missiles; and (e) equip all Bloc all-weather fighters and some Bloc day fighters with air-to-air missiles or unguided rockets of various types. [21]

90. We believe the surface-to-air missile defense around Moscow to be a special case dictated by the special importance of the city to the USSR. Considering the restricted azimuth coverage of individual sites and the great expense of the 57 fixed installations, we do not believe that Moscow-type surface-to-air defenses would be deployed at a similar level of defense in any additional Soviet areas, except possibly Leningrad. During the next year or two, it is probable that a few additional critical areas in the USSR will be provided with relatively high levels of surface-to-air missile defenses, employing missiles of the current Moscow type. Thereafter, the most critical areas will probably be supplied with improved systems, and a larger number of critical areas, as well as field units, installations, and naval vessels will be provided with lower levels of surface-to-air defense. By 1962, many more of the major Soviet cities and industrial areas, as well as military forces and

[20] In view of his estimate of a later operational capability date for the low-altitude surface-to-air system the Assistant Chief of Staff, Intelligence, USAF, believes that the USSR is unlikely to have produced sufficient missiles to equip as many as 175 units by mid-1962. See his footnote to paragraph 85.

[21] These estimates are based primarily on a consideration of Soviet requirements, resource availability and industrial capacity to produce air defense missile systems as part of an over-all Soviet military program. For further details and a fuller description of the estimative method employed and the uncertainties involved, see NIE 11-5-57, "Soviet Capabilities and Probable Programs in the Guided Missile Field," 12 March 1957.

installations, will probably be provided with surface-to-air missile defense against manned aircraft and cruise-type missiles. It is possible that some major Satellite targets will also be so defended.

91. A limited number of nuclear warheads could now be incorporated into Soviet surface-to-air missiles. We estimate that some high-altitude surface-to-air missiles, and possibly some large caliber air-to-air rockets or guided missiles, will be so equipped during the period of this estimate. However, the estimated availability of fissionable materials, and other high-priority needs, would impose limitations on the number of air defense weapons so equipped.

Anti-Aircraft Artillery

92. Pending the availability and deployment of adequate numbers of guided missiles, the Bloc will probably continue to place considerable reliance on AAA, particularly for low-altitude defense. It is possible that a multi-barrelled, Gatling-type gun of about 30 mm will be developed for low-altitude defense. As guided missile systems become available in greater quantity, the USSR will probably phase out a large proportion of its medium and some light AA guns, transferring them to other Bloc nations.

TRENDS IN EARLY WARNING AND INTERCEPT CONTROL CAPABILITIES

93. The speeds of currently operational US aircraft are such that a large proportion of critical Soviet target areas, including Moscow, could now be provided with more than one hour's early warning by ground-based radars sited on the Bloc's borders, and some areas could be provided with at least two hours' warning. One of the most serious problems Soviet air defense planners face is the marked decrease in warning time that will result as the speeds of Western offensive delivery vehicles increase. Even assuming maximum theoretical radar ranges, Soviet planners probably estimate that by 1960–1962 Moscow might be subjected to aircraft attack with only about 40 minutes' early warning from ground-based radars, and that even the deepest interior regions might not be assured of two hours' warning by such radars. The problem of adequate warning against aircraft attack is already critical in the case of important Soviet border targets such as Murmansk, Leningrad, Odessa, Baku, and Vladivostok.[22] Moreover, warning time for all areas will be reduced radically when Western weapon systems include long-range ballistic missiles, against which the USSR is unlikely to have effective defense systems by 1962.

94. Soviet early warning requirements can be expressed as ranging from *full warning*, based on the time required to alert and effectively employ the maximum serviceable air defense forces, to *alert warning*, based on the minimum time required to effectively employ those air defense forces maintained in an alert status. We are unable to judge accurately the amount of time the USSR would require for full warning, although we believe it might be at least two hours. However, during the period of this estimate, the alert warning requirements for Soviet fighter interceptors would probably be about 12–15 minutes, to permit fighters in two-minute alert status to make straight-line intercepts in the least possible time against high-altitude aircraft headed directly toward the fighter base. For surface-to-air missile units in five-minute alert status, about 9–11 minutes' alert warning would probably be required to permit initial engagement at maximum missile range. The required performance characteristics of associated radar equipment, based on a 500 knot attack at 45,000 feet in 1957 and a 1,200 knot attack at 60,000 feet in 1960–1962, would be about as follows:

500 Knot Attack	Early Warning Range (n.m.)	GCI Range (n.m.)
Opposed by interceptor	150	80
Opposed by 25 n.m. missile	100	---
1,200 Knot Attack		
Opposed by interceptor	315	215
Opposed by 50 n.m. missile	240	---
Opposed by 100 n.m. missile	310	---

[22] For estimated current and future warning lines, see Annex C, Map 2.

95. Based on observed trends and estimated Soviet capabilities in radar development, we estimate that reliable early warning detection ranges against B–47 size aircraft at high altitudes will probably increase from the TOKEN's present capabilities of 80–180 n.m. to 200–260 n.m. in 1960, and that reliable detection ranges will approximate 260 n.m. in 1962. Against F–86 size aircraft, reliable detection ranges will be on the order of 120–170 n.m. by the end of the period. The reliable detection capability of Soviet GCI radar against B–47 size aircraft will probably increase from 50–110 n.m. at present to 150–250 n.m. by 1962, and against F–86 size aircraft from 40–70 to 90–140 n.m. By 1962, Soviet GCI radars will probably be capable of accurate heightfinding up to the combat ceilings of Western bombers and cruise-type missiles in operational use at that time. We estimate that, through the period, these increasing radar capabilities can probably meet the alert warning requirements for those areas where some defense in depth is available (i.e., areas where radars and defense weapons can be stationed forward of the targets to be defended), and for peripheral areas as well, except against the highest-performance aircraft and cruise-type missiles. However, for the defense of targets on the periphery of the Bloc against the highest-performance Western aircraft and cruise-type missiles, the alert warning capabilities of ground-based radars alone will probably be deficient for fighter interceptors and marginal for surface-to-air missile defenses.

96. A further increase in Bloc warning capabilities could be achieved by the employment of airborne early warning systems, and there is some evidence that the USSR is engaged in the development of such systems. We also have some evidence that individual Soviet cruisers and destroyers in the Baltic and Black Seas have been involved in air early warning exercises. Although we have no evidence that airborne early warning or radar picket ships are being employed as a permanent segment of the Bloc's early warning system, we estimate that the USSR will probably employ these methods for extending early warning coverage in at least a few areas by mid-1962.

97. The number of operational Bloc early warning and GCI radar sites will probably increase to a total of nearly 700 by mid-1962. By that time, all prime early warning sites will probably consist of an air search radar and a heightfinder, supplemented by as many as three gap-fillers providing low-altitude coverage. All GCI sites will probably consist of one air search radar and two heightfinders.[23] As improved radars are introduced into the heavily-defended areas of the Bloc, older models will probably be deployed to areas where coverage is now sparse or nonexistent. By the end of the period, the Bloc will probably have complete ground-based radar coverage, with the exception of China's southwest border and some inland portions of Siberia, west-central China, and Mongolia.

98. Close control of interception will probably be improved by increases in the traffic-handling capability of communications equipment. The improved GCI equipment estimated for the period will probably have a traffic-handling capacity of about 12 simultaneous interceptions. The limitations imposed by current air-ground communications equipment will probably be reduced by conversion to 8–12 channel VHF. This conversion will probably be completed in Soviet forces by 1960, and possibly in the Satellites by 1962. We also believe it possible that air-ground data-link equipment will be developed and placed in operation by 1962.

TRENDS IN OTHER ELEMENTS OF AIR DEFENSE CAPABILITIES

99. *Air Facilities.* Considerable emphasis will continue to be placed on airfield construction in the Bloc. Most newly-constructed fighter fields will probably have runways in excess of 7,000 feet, and a program of extending shorter fields will probably be pursued to keep pace with the introduction of higher performance aircraft. We estimate that a high priority will continue to be placed on airfield construc-

[23] For a detailed numerical estimate, see Annex B, Table 6.

tion in the northern and eastern peripheral areas of the USSR. Airfield development will probably also occur during the period in the industrialized areas of the USSR lying along the Trans-Siberian Railroad north of Mongolia and Manchuria, but with considerably less emphasis than in the Arctic areas. There will probably be a considerable improvement in the POL situation by 1962, with some increase in airfield storage capacity.

100. *Command and Coordination.* Throughout the period of this estimate, major efforts will probably be directed toward improving Bloc capabilities in regard to air defense reporting, command reaction, and coordination. Ground-to-ground communications capacities will be increased by the extension of land-lines, microwave relay systems, teleprinter links, and possibly scatter communications. By 1962, a limited automatic data-handling capability will probably exist in the more critical areas. Despite such technological improvements, communications saturation problems will continue to exist. Increased autonomy for air defense controllers at the lower echelons may result from the requirement for rapid local command reaction.

101. *ECM.* Bloc ECM capabilities will improve through 1962. At that time the USSR could have equipment capable of jamming at frequencies up through 18,000 mc/s and possibly higher, although its effectiveness cannot be estimated. The USSR could also develop devices to enable missiles to home on electronic emissions. To decrease vulnerability to jamming, Soviet radars will probably employ greater frequency spreading during the period, and other antijamming techniques are probably now under development. Land-lines and microwave links will be used increasingly during the period. Nevertheless, defensive electronic systems will continue to be susceptible to ECM, and in this field it is expected that the advantage is likely to fluctuate between the offense and the defense. We estimate that through the period of this estimate, Bloc air defense electronic systems will still be subject to progressive disruption by properly employed diversionary tactics, decoys, saturation techniques, and other countermeasures.

ANNEX A

ECONOMIC IMPACT OF AIR DEFENSE PROGRAMS

Air Defense Costs, 1957–1962

1. The costs of the air defense programs which we have outlined in the DISCUSSION have been measured in aggregate terms. While we recognize that monetary calculations of Soviet military costs are only approximations, they do permit the establishment of reasonable magnitudes with which to weigh the economic impact of the estimated programs. Such calculations also serve as an indication of the priority and effort which would be required and the possible effects on other military and industrial programs. We estimate that the total annual cost of Bloc air defense programs would be about 62 billion rubles ($13 billions) for 1957, rising to a peak of about 111 billion rubles ($22 billions) in 1961, and then declining somewhat to about 104 billion rubles ($21 billions) in 1962.[1] Figure 1 shows how total costs are allocated through time and by principal air defense function.

2. The estimated initial and operating costs from 1957 to 1962 are detailed in Figure 2 by subcategories of programs. The annual initial costs of Bloc air defense programs would rise from about 36 billion rubles in 1957 to a peak of approximately 70 billion rubles in 1961 and then decrease somewhat to about 60 billion rubles in 1962. It should be noted that total initial costs exceed total operating costs. Because the guided missile program starts from a low base there is a very large ratio of initial to operating costs through 1961. This ratio for other programs varies somewhat from year to year according to the quantity of equipment introduced into the air defense system.

3. The over-all impact of these costs may be illustrated as follows: if the total of all Bloc military expenditures remains in conformity with that estimated in NIE 11–4–56,[2] the proportion allocated to air defense programs would rise from about 25 percent of the total in 1957 to about 35 percent in 1961; expenditures for military programs other than air defense would have to decline somewhat below our previous estimates. If, on the other hand, expenditures for these other military programs remain as previously estimated, the result would be an increase of about six percent in our estimate of total Bloc military expenditures by 1961.

4. Most of the research and development, specialized equipment, and highly trained manpower needed for the air defense of the Bloc will have to be provided by the USSR. Initial Soviet air defense expenditures would increase sharply through 1960 and operating expenditures would increase by more than 80 percent (see Figure 3). The air defense programs of the USSR are estimated to constitute 28 percent of total Soviet military expenditures for 1957. If total Soviet military expenditures remain at the levels estimated in NIE 11–4–56, air defense programs would take an increasing share of the total, reaching 43 percent by 1961. If Soviet military programs other than air defense were maintained at previously estimated levels and additional resources were provided to accommodate the air

[1] For convenience of comparison among estimates, 1951 rubles are used throughout this analysis. The dollar expenditures are based on price relationships existing in the US in 1955.

[2] Military expenditures by the USSR during the period 1955–1961, were estimated in NIE 11–4–56, "Soviet Capabilities and Probable Soviet Courses of Action through 1961," published 2 August 1956. Since corresponding agreed estimates of the military expenditures of other Bloc countries do not exist, tentative estimates have been made for the purposes of the above paragraph. Even should such tentative estimates prove to be considerably in error, the conclusions arrived at would not be materially altered, since expenditures by the USSR are estimated to comprise 85–90 percent of total Bloc air defense outlays (see Figure 3).

defense programs, the 1961 allocation to air defense would be 40 percent of total military expenditures, compared with the 36 percent estimated in NIE 11–4–56.

5. Air defense programs would thus constitute an appreciable burden upon the Bloc's economy. We believe that the cost would be such as to require either some diversion of industrial resources from other military programs as previously estimated, or an increase in total military expenditures.

Electronics and Telecommunication Equipment

6. The electronics requirements for air defense are very great, involving an increase of approximately 300 percent between 1957 and 1961. These requirements would absorb a substantial portion of the output of the electronics and telecommunication equipment industry of the Bloc throughout the period, despite the fact that this industry is growing at a rapid rate. Satisfaction of the demands of the air defense programs would permit only small increases in electronics production for other military, industrial, and civilian purposes. We do not believe that fulfillment of electronics requirements would offer such an obstacle as to make these air defense programs impossible. We are certain, however, that some quite difficult choices will have to be made among military programs, industrial automation, and consumer goods during the period of this estimate.

Other Equipment

7. An examination of Soviet Bloc industrial facilities available to fulfill air defense procurement requirements reveals no other apparent restrictions. The total poundage of required fighter aircraft and engine production would increase about one-third by 1961. These demands are within the capacity of the industry. Similarly, with the possible exception of electronics, the guided missile production program is believed to be within the economic capacity of the Bloc. Although the air defense programs would not require major portions of the supply of basic materials, fulfilling their requirements would impose further pressures on the already tight supply of such commodities as steel and construction materials. Manpower limitations seem unlikely to place any general restrictions on the program, although some qualitative problems might develop in the precision engineering skills.

FIGURE 1

ESTIMATED SINO-SOVIET BLOC AIR DEFENSE PROGRAMS

1957 - 1962

(billion 1951 rubles)

	1957	1958	1959	1960	1961	1962
Guided Missile Programs	8.6	13.1	23.8	39.4	44.4	34.6
Aircraft Programs	21.4	24.9	27.3	28.7	29.8	29.6
AAA Programs	12.2	12.2	12.1	12.1	12.0	12.0
Control & Warning Programs	3.7	4.1	4.7	4.8	5.0	5.1
Related Programs*	15.9	16.6	17.5	18.5	19.8	22.3
Total	61.8	70.9	85.4	103.5	111.0	103.6

* Represents a generalized estimate of those portions of reserve, militarized MVD, research and development, and nuclear energy costs which would properly be chargeable to air defense. The overwhelming bulk of these outlays are in R. and D. and nuclear energy costs.

FIGURE 2

ESTIMATED INITIAL AND OPERATING COSTS

SINO-SOVIET BLOC AIR DEFENSE PROGRAMS

1957 - 1962

(billion 1951 rubles)

	1957	1958	1959	1960	1961	1962
Initial Costs						
Guided Missiles	7.0	9.6	17.8	30.5	31.4	18.3
Aircraft	12.0	14.5	16.3	16.6	17.2	16.6
AAA	.4	.4	.4	.4	.2	.2
Control & Warning	1.3	1.5	2.0	2.0	2.0	2.0
Subtotal	20.7	26.0	36.5	49.5	50.8	37.1
Related Programs*	15.9	16.6	17.5	18.5	19.8	22.3
Total Initial Costs	36.6	42.6	54.0	68.0	70.6	59.4
Operating Costs						
Guided Missiles	1.6	3.5	6.0	8.9	13.0	16.3
Aircraft	9.4	10.4	11.0	12.1	12.6	13.0
AAA	11.8	11.8	11.7	11.7	11.8	11.8
Control & Warning	2.4	2.6	2.7	2.8	3.0	3.1
Total Operating Costs	25.2	28.3	31.4	35.5	40.4	44.2
Total Air Defense Costs	61.8	70.9	85.4	103.5	111.0	103.6

* Considered as an initial cost item for purposes of general analysis, since the overwhelming bulk is in R. and D. and nuclear energy costs.

FIGURE 3

ESTIMATED INITIAL, OPERATING, AND RELATED AIR DEFENSE COSTS

USSR *Only*

1957 - 1962

(billion 1951 rubles)

	Initial	Operating	Related	Total	Percent of Total Bloc Costs
1957	20	18	16	54	87
1958	24	21	17	62	87
1959	34	24	17	75	88
1960	48	26	19	93	89
1961	49	30	20	99	89
1962	34	33	23	90	87

ANNEX B

TABLES OF AIR DEFENSE EQUIPMENT

Characteristics, Strength, and Deployment

TABLE 1

ESTIMATED OPTIMUM PERFORMANCE OF SOVIET JET INTERCEPTOR AIRCRAFT

(INTERNAL FUEL ONLY)

(Calculated in accordance with US Mil C-5011A Spec except that fuel reserves are reduced to permit a maximum of 20 minutes maximum endurance at sea level and aircraft operate at altitudes permitting maximum radius)

	FAGOT Day Fighter	FRESCO A & B Day Fighters	FRESCO C & D [1]	FARMER Day Fighter	FLASH-LIGHT A All-weather Fighter	1957 FLASH-LIGHT C All-weather Fighter	1957 FACE-PLATE Day Fighter	1958 All-weather Fighter	1958 FITTER Day Fighter	1959 All-weather Fighter	1962 All-weather Fighter
Maximum Speed (kts)											
Sea Level	580	620	635	680	610	635	700	690	800	800	800
35,000 ft	525	555	575	710	540	575	895	860	1,185	1,150	1,440
40,000 ft	525	550	570	700	540	570	850	---	1,150	---	---
Combat Ceiling (ft) [2]	51,000	54,800	58,900	60,900	49,300	54,700	61,300	60,000	60,400	62,000	67,000
Combat Radius (nm)	225	300	215	245	450	295	215	250	140	130	200
Time to Climb to 40,000 ft (minutes) [3]	7.5	6.2	3.7	2.6	7.8	8.6 [4]	3.8 [4]	4.0 [4]	3.5 [4]	3.0 [4]	1.7
Armament											
Guns	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x37 mm and	2x37 mm and	3x23 mm or 3x30 mm and	2x37 mm and	3x30 mm or 3x37 mm and	1x37 mm or 1x30 mm and	---
Rockets					50x2"-3" or	76x55 mm or 4x325 mm or	2x325 mm or 2x210 mm or	2x325 mm or 2x210 mm or	2x210 mm or 2x325 mm or	38x55 mm or 2x220 mm or	2x210 mm or
Guided Missiles					4 AAM	4 AAM	2 AAM	4 AAM	2 AAM	2 AAM	4 AAM

[1] FRESCO C is a day fighter, FRESCO D has a limited all-weather capability. FRESCO E is the same as D but without afterburner and would have about the same performance as the A and B.
[2] Combat ceiling is the altitude where rate of climb is 500 ft/min immediately prior to combat with maximum power.
[3] Data shown at take-off gross weight (see DISCUSSION, para. 77 and footnotes).
[4] Military power (without afterburner).

TABLE 2

ESTIMATED OPTIMUM PERFORMANCE OF SOVIET JET INTERCEPTOR AIRCRAFT

(WITH EXTERNAL FUEL EXCEPT WHERE NOTED)

(Calculated in accordance with US Mil C-5011A Spec except that fuel reserves are reduced to permit a maximum of 20 minutes maximum endurance at sea level and aircraft operate at altitudes permitting maximum radius)

Maximum Speed (kts)	FAGOT Day Fighter	FRESCO A & B Day Fighters	FRESCO C & D [1]	FARMER Day Fighter	FLASH-LIGHT A All-weather Fighter	1957 FLASH-LIGHT C All-weather Fighter	1957 FACE-PLATE Day Fighter	1958 All-weather Fighter [2]	1958 FITTER Day Fighter	1959 All-weather Fighter	1962 All-weather Fighter [3]
Sea Level	580	620	635	680	610	635	700	690	800	800	800
35,000 ft	525	555	575	710	540	575	895	860	1,185	1,150	1,440
40,000 ft	525	550	570	700	540	570	850	---	1,150	---	---
Combat Ceiling (ft)	50,700	53,900	57,900	59,500	48,700	54,000	59,600	60,000	60,400	62,000	67,000
Combat Radius (nm)	360	610	500	655	530	385	610	250	480	440	200
Time to Climb to 40,000 ft (minutes) [4]	8.7	7.6	4.5	7.9	8.4	9.5 [5]	6.3 [5]	4.0 [5]	5.6 [5]	5.1 [5]	1.7
Armament											
Guns	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x23 mm 1x37 mm	2x37 mm and	2x37 mm and	3x23 mm or	2x37 mm and	3x30 mm or	1x37 mm or	---
Rockets					50x2"-3" or	76x55 mm or	3x30 mm and 2x325 mm or	2x325 mm or	3x37 mm and 2x210 mm or	1x30 mm and 38x55 mm or	2x210 mm or
Guided Missiles					4 AAM	4x325 mm or 4 AAM	2x210 mm or 2 AAM	2x210 mm or 4 AAM	2x325 mm or 2 AAM	2x220 mm or 2 AAM	4 AAM

[1] FRESCO C is a day fighter, FRESCO D has a limited all-weather capability. FRESCO E is the same as D but without afterburner and would have about the same performance as the A and B.
[2] Internal fuel only.
[3] Data shown at take-off gross weight (see DISCUSSION, para. 77 and footnotes).
[4] Military power (without afterburner).

TABLE 3

ESTIMATED CHARACTERISTICS OF
SOVIET ANTIAIRCRAFT ARTILLERY

WEAPON	CALIBER	WEIGHT OF PROJECTILE	EFFECTIVE CEILING	MUZZLE VELOCITY	RATE OF FIRE
14.5 mm AA HMGs (single, dual, and quadruple barrelled)	14.5 mm (0.57 in)	0.12 lb	3,500 ft	3,200 to 3,500 fps	500 rpm per barrel
37 mm Automatic AA Gun, M 1939	37 mm (1.46 in)	1.61 lb	4,500 ft	2,900 fps	160 to 180 rpm
57 mm AA Gun M 1950	57 mm (2.24 in)	6.0 lb	6,000 ft (with on-carriage sight) 15,000 ft (with off-carriage fire control including radar)	3,400 fps	130 to 150 rpm
85 mm AA Gun, M 1944	85 mm (3.35 in)	21.23 lb	30,000 ft	2,950 fps	15 to 20 rpm
100 mm AA Gun, M 1949	100 mm (3.94 in)	35 lb	35,000 ft	3,200 fps	20 to 25 rpm
122 mm AA Gun, M 1955 (?)	122 mm (4.8 in)	55 lb	40,000 to 45,000 ft	3,300 fps	10 to 12 rpm

TABLE 4

SOVIET AIR DEFENSE GUIDED MISSILE DEVELOPMENT PROGRAM THROUGH 1962[1]

SURFACE-TO-AIR MISSILE SYSTEMS

Designation[2]	First Operational Capability Date[3]	Maximum Altitude (ft.)	Maximum Horizontal Range (n.m.)	Accuracy (CEP in ft.)	Payload[4] (lbs. and type)	Maximum Speed (Mach No.)	Guidance	Remarks
Ground-Launched								
SA-1	mid-1955	60,000	20 (1955) 25 (1957)	50 or 190	600–700 nuclear or HE	2.0–2.5	Command type (190′ CEP); mid-course command with terminal homing probably semiactive (50′ CEP).	First operational capability simultaneous with decision to series produce. Characteristics are those estimated for early 1957.
SA-2	1958[6]	40,000	15	50	150 HE	2.0	Semiactive homing.	For low altitude defense.
SA-3	1959	80,000	50	100 or 500	500–800 nuclear or HE	3.0	Command type (500′ CEP); command with homing (100′ CEP).	
SA-4	1961	90,000 or 60–80,000	100	100 or 500	500 nuclear or HE	4.0 or 2.5	Command type (500′ CEP); command with homing (100′ CEP).	Alternate systems possible, using either rocket or ram-jet propulsion. See NIE 11-5-57, para. 65.
Shipborne								
SA-6	1958	40,000	15	50	150 HE	2.0	Beam riding and/or semi-active homing.	Could be modified for dual-purpose use as surface-to-surface missiles in appropriate naval roles.
SA-7	1960	80,000	50	100 or 500	500–800 nuclear or HE	3.0	Command type (500′ CEP); command with homing (100′ CEP).	

[1][2][3][4][6] On next page.

TABLE 4 (Cont.)

SOVIET AIR DEFENSE GUIDED MISSILE DEVELOPMENT PROGRAM THROUGH 1962[1] (Cont.)

AIR-TO-AIR MISSILE SYSTEMS

Designation[2]	First Operational Capability Date[3]	Maximum Range (n.m.)	Accuracy (CEP)	Payload[4] (lbs. and type)	Maximum Speed[5] (Mach No.)	Approx. Gross Weight (lbs.)	Guidance	Remarks
AA-1	1955	2-3	30 ft.	25 HE	2.0	175	Passive infrared homing.	Tail-cone attack in good weather.
Beam-rider	Now[7]	5 if launched at 50,000'	30 ft.	45 HE	2.0	335	Beam-rider.	All-weather. See para. 31.
AA-2	1958	5	40 ft.	50 HE	2.0	300-450	Semiactive homing.	All-weather.
AA-3	1960	15-20 if launched at 60,000'	50 ft.	150 nuclear or HE	2.0	800	Semiactive homing or infrared homing.	All-weather or tail-cone attack.

[1] We evaluate this program as probable, with varying degrees of confidence concerning detailed characteristics. The only missile for which our estimate is supported by significant current intelligence is the SA-1, which is now in operation in the Moscow area. For further details regarding the systems summarized in this table, see NIE 11-5-57, "Soviet Capabilities and Probable Programs in the Guided Missile Field," 12 March 1957.

[2] These are arbitrary designations for convenience of reference, as used in NIE 11-5-57.

[3] Except where otherwise indicated in the Remarks, the date given is the earliest probable time at which one or more series produced missiles could have been placed in the hands of trained personnel, thus constituting a limited capability for operational employment. See NIE 11-5-57, paragraph 50.

[4] Payload includes explosive device and its associated fuzing and firing mechanism. For appropriate Soviet nuclear warhead capabilities, see NIE 11-2-57, Part I, Soviet Atomic Energy Program, dated 7 May 1957, limited distribution.

[5] It is the view of the Assistant Chief of Staff, Intelligence, USAF, that the USSR would be unlikely to have an effective all-weather, land based, low altitude surface-to-air missile system in operational use prior to 1960-1961. See his footnote to NIE 11-5-57, paragraph 62.

[6] Does not include speed of launching aircraft.

[7] Based on newly-acquired intelligence, we estimate that an air-to-air missile of this type has been under development and could probably be in operational use now. The questions of its first operational capability date and its relationship to other air-to-air missiles in the estimated program are under study.

TABLE 5

ESTIMATED ACTUAL BLOC JET FIGHTER STRENGTH
IN OPERATIONAL UNITS

(Current and Projected)

	Mid-1957	Mid-1960	Mid-1962*
USSR			
Day	8,880	5,800	4,150
All-weather	1,320	4,350	5,850
Subtotal	10,200	10,150	10,000
EUROPEAN SATELLITES			
Day	1,865	2,850	2,700
All-weather	55	350	700
Subtotal	1,920	3,200	3,400
ASIATIC COMMUNIST			
Day	1,835	2,350	2,100
All-weather	60	250	750
Subtotal	1,895	2,600	2,850
BLOC TOTALS			
Day	12,580	11,000	8,950
All-weather	1,435	4,950	7,300
ALL TYPES	14,015	15,950	16,250

* On the basis of probable Soviet requirements and demonstrated production capabilities, we estimate that by mid-1962 the Soviet fighter force might have approximately 60 percent of its strength in all-weather fighters. With regard to the over-all number of manned interceptors to be maintained in Soviet operational units, we can estimate only that the USSR will probably not increase its present fighter strength, and that a decision will probably be made to begin cutting it back some time late in the period of this estimate. On this basis, we hold estimated Soviet fighter strength constant at about 10,000 aircraft through mid-1962, recognizing that the timing of the Soviet decision will depend largely on the USSR's actual progress in the guided missile field. The magnitude of the increase in fighter strength in the European Satellites and Asiatic Communist countries is also uncertain, but in any case, the bulk will comprise older models retired from Soviet forces as the USSR introduces higher performance aircraft into its own units. See DISCUSSION, paragraphs 78–80.

TABLE 6

ESTIMATED OPERATIONAL BLOC AIR DEFENSE RADARS

(Current and Projected)

OPERATIONAL SITES	Mid-1957	Mid-1960	Mid-1962
Prime Early Warning [1]			
TOKEN	240	110	100
NEW TYPE	---	145	175
(TOTAL)	240	255	275
GCI [2]			
TOKEN	290	145	95
NEW TYPE	---	240	295
(TOTAL)	290	385	390
Gap-Fillers [3]	1,065	1,000	1,000
OPERATIONAL RADAR EQUIPMENTS			
Air Search Types			
TOKEN	600	600	600
Gage and other new types	25	405	495
Heightfinder Types			
ROCK CAKE and PATTYCAKE	85	785	1,075
Fire Control Types			
AAA	3,100	4,100	5,100
Surface-to-air-missile guidance systems [4]	70	685	1,600
Miscellaneous Types			
Lend-lease, Japanese, old Soviet 70-80 mcs types, etc.	2,400	1,900	1,500

[1] At present, most prime EW sites consist of one TOKEN and one miscellaneous type radar. We estimate that by 1962 each early warning site will consist of one air search type radar and one heightfinder.

[2] At present, most GCI sites consist of one TOKEN and one miscellaneous type; heightfinders are being added as they become available. We estimate that by 1962 each GCI site will consist of one air search radar and two heightfinders.

[3] Present gap-filler radars consist of miscellaneous lend-lease and Japanese types and old Soviet 70-80 mcs types. By 1962, many of these will probably have been replaced by TOKENs phased out of EW and GCI roles, and possibly also by newer types designed especially for the gap-filler role.

[4] Estimated numbers for mid-1957 consist entirely of YOYO guidance systems.

TABLE 7

ESTIMATED ACTUAL STRENGTH AND DEPLOYMENT OF CERTAIN SINO-SOVIET BLOC AIR DEFENSE EQUIPMENT[1] (MID-1957)

AREA	JET FIGHTER AIRCRAFT IN OPERATIONAL UNITS			JET FIGHTER REGIMENTS	RADARS			ANTIAIRCRAFT ARTILLERY	
	Day	All-weather	Total		Early Warning Sites	GCI Sites	Gap-Filler	Medium	Light
Northwestern USSR[1]	1,380	220	1,600	50	22	27	80	900	1,300
Western USSR[2]	1,760	320	2,080	65	38	58	127	2,850	4,450
West Central USSR[3]	1,340	260	1,600	50	43	48	117	2,400	1,400
Caucasus[4]	1,185	150	1,335	42	25	30	73	1,150	1,300
East Central USSR[5]	470	50	520	16	12	6	36	800	900
Far Eastern USSR[6]	1,675	240	1,915	60	46	32	150	1,700	2,550
TOTAL WITHIN USSR	7,810	1,240	9,050	283	186	201	583	9,800	11,900
Soviet Forces in Eastern Europe[7]	1,070	80	1,150	36	Subordination not estimated			950	2,400
(TOTAL SOVIET)	(8,880)	(1,320)	(10,200)	(319)	---	---	---	(10,750)	(14,300)
Satellite Nations[8]	1,865	55	1,920	53[9]	Subordination not estimated			2,650	2,350
TOTAL EASTERN EUROPE	2,935	135	3,070	89	46	64	172	3,600	4,750
Asiatic Communist Nations[10]	1,835	60	1,895	58[11]	8	25	310	1,450	2,200
TOTAL BLOC	12,580	1,435	14,015	430	240	290	1,065	14,850	18,850

[1] Includes Northern, Leningrad, and White Sea Military Districts.
[2] Includes Baltic, Belorussian, Carpathian, Kiev, Odessa, and Tauric Military Districts.
[3] Includes Moscow, South Ural, Volga, Voronezh, and Ural Military Districts.
[4] Includes North Caucasus and Transcaucasus Military Districts.
[5] Includes Siberian and Turkestan Military Districts.
[6] Includes Far East and Transbaikal Military Districts.
[7] Includes Soviet forces stationed in East Germany, Poland, Hungary, and Rumania.
[8] Radar and AAA figures include Albania, Bulgaria, Rumania, Hungary, Czechoslovakia, Poland, and East Germany. Fighter figures include all but Hungary, whose fighter forces are believed to be inoperative at present.
[9] In addition, there are believed to be four piston fighter regiments operational in the East German air establishment at present.
[10] Fighter and radar figures include Communist China and North Korea. AAA figures include Communist China, North Korea, and Viet Minh.
[11] In addition, there is believed to be one piston fighter regiment operational in Communist China at present.

TABLE 8

SINO-SOVIET BLOC AIR DEFENSE OPERATIONAL PERSONNEL

(MID-1957)

FUNCTION	BLOC	USSR	EUROPEAN SATELLITES	ASIATIC COMMUNIST STATES
Fighter Aviation	350,000	250,000 [1]	45,000	55,000
Antiaircraft Artillery	935,000	580,000 [2]	155,000	200,000
Surface-to-Air Guided Missiles	25,000	25,000	---	---
Air Defense Control and Warning [3]	105,000	75,000	15,000	15,000
TOTAL	1,415,000	930,000	215,000	270,000

[1] Includes fighter elements of IA PVO (88,000 personnel), Tactical Aviation (115,000 personnel) and Naval Aviation (47,000 personnel).

[2] Includes AAA troops in shore establishments of naval fleets.

[3] This function includes air defense headquarters staff, district staff, district control center and administrative personnel, as well as radar early warning, ground control intercept and communication personnel. In addition, the Bloc's air defense system is served by visual observer personnel who are not included in these totals.

ANNEX C

MAPS

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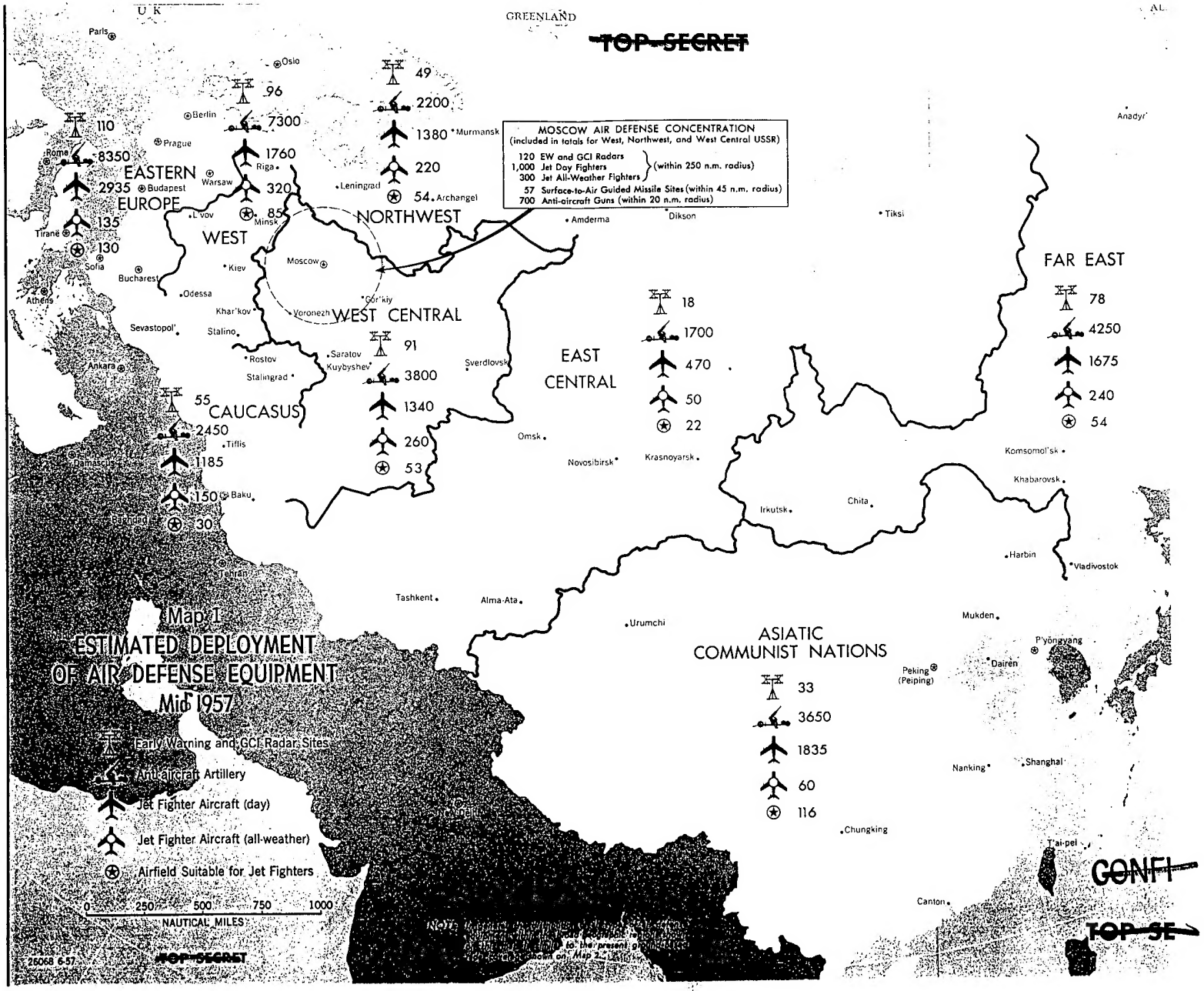

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Map 2

ESTIMATED LIMITS OF BLOC EARLY WARNING CAPABILITIES, 1957 AND 1962